



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

T H E

AMERICAN NATURALIST.

Vol. VIII. — FEBRUARY, 1874. — No. 2.



THE YELLOWSTONE NATIONAL PARK.

BY THEO. B. COMSTOCK, B.S.



I. ITS SCIENTIFIC VALUE.

It is now generally understood that a bill was passed by the 41st Congress, by which the tract of land known as the "Yellowstone National Park" was "reserved and withdrawn from settlement, occupancy or sale under the laws of the United States, and dedicated and set apart as a public park or pleasuring-ground for the *benefit* and enjoyment of the people."

The writer of this article, having spent some weeks during the past summer in the study of the geological features of this remarkable region, has visited all its points of interest, and collected much material for the elaboration of a report, which is now in course of preparation. Dr. Hayden has already led two well equipped expeditions into this country,* while smaller parties have gathered more or less valuable material concerning the phenomena there exhibited.† The leaders of all of these expeditions

* See Geological Survey of Montana, etc, 1871; also Geological Survey of Montana, Idaho, Wyoming and Utah, 1872.

† In this connection it is but just to mention the names of Cook and Folsom, who ascended the Yellowstone valley and visited the Madison River geysers in 1869; Lieut. G. C. Doane, 2nd U. S. Cavalry (accompanying Gen. Washburn) in 1870, who reported briefly to Gen. Hancock; and Capts. Barlow and Heap, U. S. Engineer Corps, whose report to Gen. Sheridan was published in 1872. Hon. N. P. Langford, ex-governor of Montana, now superintendent of the park, has also published a number of interesting popular articles concerning its marvels.

seem to have been satisfied with the conclusion reached by Colonel Wm. F. Reynolds, who, attempting to reach this region from the head waters of Wind River without success, decided that such a route was wholly impracticable. Since 1859, the date of Reynolds' expedition, all explorers have taken it for granted that the sources of Wind River can only be reached from the head waters of Yellowstone River, by making a *détour* so as to cross the Wind River mountains through Union pass. Impressed with this idea, entrance has heretofore been made from the northward by way of forts Ellis and Bozeman in Montana, with the one exception of a portion of Dr. Hayden's command of last year, which entered by ascending the valley of Snake River, under the guidance of Mr. James Stevenson. It was natural, therefore, that much interest should attach to the results attained by an expedition, which took the field during the past summer, with the expressed intention of solving as much as possible of the mystery overhanging the structure of the unexplored territory adjacent to the park on the south and east.* The northwestern Wyoming expedition, under the command of Capt. W. A. Jones, Chief Engineer of the Department of the Platte, after an extended tour of exploration among the complicated mountain ridges of the Wind River drainage, entered the park by a new route. Ascending one of the forks of the Stinking Water† to its source in the high and rugged volcanic wall

* The interesting geological results of this expedition are enumerated in an article by the writer, on the Geology of Western Wyoming, in the Amer. Jour. of Sci., Dec., 1873.

† I have elsewhere referred to the frequent and confusing repetition of geographical names in the west, for which no remedy seems available. I am here obliged to note that the Stinking Water *River*, to which I now allude, is an important tributary of the Big Horn, and *not* the Stinking Water *Creek* so often mentioned by Hayden, which is a tributary of Jefferson Fork of the Missouri. Stinking Water *River* is in Wyoming, Stinking Water *Creek* in Montana.

While upon this subject I would ask if some measures cannot be adopted to prevent this annoying confusion of names. Why would it not be wise to substitute, as far as possible, in future maps, the more attractive Indian names for the most *abused* of those now in use? Certainly the majority of the Indian names are much preferable to their English translations.

In order to show the extent of this polynomial evil I have compiled the following list of the names of streams, which occur more than once within a distance of three hundred miles of Yellowstone Lake, all within the limits of Wyoming, Montana, Idaho, and northern Utah, but the majority are found within a radius of one hundred miles of the Park: Henry's Fork 2, Smith's Fork 3, Lake Fork 2, Bear River 2, White River 3, Powder River 2, John Day's River 2, Téton River 2, Snake River 2, Sage Creek 5, Cottonwood 3, Muddy 5, Dry Creek 4, Clear Creek 2, Sour Creek 2, Deep Creek 2, Spring Creek 3, Beaver Creek 3, Elk Creek 3, Deer Creek 2, Black-tailed Deer Creek 2, Bitter Root Creek 2, Yellow Water Creek 2, Stinking Water 2. Thus we have sixty-two *distinct* but not widely separated streams designated by the use of only twenty-four names.

on the east of Yellowstone Lake, a pass was discovered through which the pack-train was guided safely, but with considerable difficulty. This route, though in some respects preferable to the present circuitous way of entering the park, is not destined to be made available to tourists, owing to the engineering difficulties to be surmounted, and the comparatively slight saving in the distance. Upon the return of the expedition, however, a very practicable entrance was discovered, by way of the head of Wind River, from the southward. Through this new pass, which Capt. Jones has appropriately named *Tō-gō-tě*,* after our Shoshone guide, a railroad may be constructed with little difficulty to connect with the Union Pacific at Rawlins, *which would save to tourists from the east at least five hundred miles of travel in each direction*. This would render the park and the Montana settlements readily accessible, and unlock the rich mineral deposits of the Wind River valley and the Sweetwater (Wyoming) mining region. Here also a fine agricultural country is awaiting development, and already herds of excellent cattle are to be seen grazing in the rich pastures of the smaller valleys.

While traversing that portion of this region now reserved for the general public, embracing the greater number of the hot springs and geysers, I was very deeply impressed with a sense of the immense amount of time and labor which must be spent in investigating the various productions and phenomena of the park, ere we can unravel its past history or fully interpret its present manifestations. By a most fortunate, though quite accidental disposition of my time, I was enabled to pass through the most interesting portion of these wonders in such a manner as to witness and note a large number of the most striking manifestations in a comparatively short space of time. And yet when I say that I could have remained for weeks in the neighborhood of a single geyser or spring, watching closely its daily and hourly pulsations and eruptions, studying its history, and marking its effects without feeling anything more forcibly than my own ignorance, it will

*In indicating the pronunciation of Indian words I have adopted, as nearly as possible with ordinary type, the admirable and comprehensive system of Dr. C. H. Berendt, as explained in his paper entitled "Analytical Alphabet for the Mexican and Central American Languages," published by the American Ethnological Society, New York, 1889.

It should be noticed that the "g" in this word has the sound of the guttural "j" of Dr. Berendt, which is the equivalent of *ch* in the German *buch*.

readily be seen that my time was all too brief for the performance of the work as I desired.

Much has already been said concerning the benefits to be derived by science from the setting aside of this tract of land and the protection of its natural features. In fact this was one of the inducements offered for the passage of the bill in both houses of Congress. Dr. Hayden, in speaking of this bill says, "I believe it will mark an era in the popular advancement of scientific thought not only in this country, but throughout the civilized world. . . . This noble deed may be regarded as a tribute from our legislators to science, and the gratitude of the nation and of men of science in all parts of the world is due them for this munificent donation."*

In this paper I propose to offer some suggestions based upon my own experience in the Yellowstone country and adjacent portions of the Rocky Mountains, tending to show some of the benefits which, in my opinion, may be made to accrue to science by the proper use of this grant. The tide of emigration, now fairly started on its westward course, is daily seeking new fields for conquest, and with the abundant treasures stored by nature in the hills and valleys surrounding our park, there can be no question that this territory is destined to become a scene of great activity at no very distant day. The Wind River valley, the greater portion of which must be traversed by any highway entering the park from this direction, is remarkably rich in mineral wealth so exposed as to make its working a problem of the simplest nature.

In a previous paper† I have briefly alluded to this fact in connection with a discussion of the prominent geological features of this highly interesting section. It is also highly probable that the once vigorous gold mining interests of South Pass and vicinity would be revived by the introduction of sufficient capital, while the markets thus produced would stimulate agriculture in a region very favorable for its successful prosecution. Nor can I doubt that the immense deposits of iron, coal, and even oil, will yet be found to be of the very greatest economic value.

In a word, it is my humble opinion that the territories adjacent to the national park will ere long be among the most thickly settled portions of the west, and that within the next decade or two

* Geological Survey of Montana and adjacent Territory, 1871, p. 162.

† On the Geology of Western Wyoming, Amer. Jour. Sci. Dec., 1873.

we may confidently hope to add to our banner another star representing a part of this region. The Montana mining settlements are already a fixed fact, and the inhabitants of the whole area alluded to, ever alive to their own interests, are rapidly developing the capacities of their soil. Dr. Cyrus Thomas, in his valuable and very interesting report to Dr. Hayden in 1871, says * “It is only after a careful examination of a vast number of experiments made in New Mexico, Colorado, Wyoming, Utah, etc., that I am forced to acknowledge what I before did not believe, viz: *that wherever there is soil in these regions, it is rich in the primary elements of fertility.*” Again he remarks,† “As a final illustration, I would refer to the efforts of the Mormons on the Rio Virgin, along the Arizonian border, where I might truly say, amid basaltic hills and drifting sands the desert is being turned into a blooming garden. Perhaps a more desolate looking region than the vicinity of St. George could scarcely have been selected; yet the application of water shows that here, as elsewhere, the soil is rich in the mineral elements necessary to fertility.”

Much of the area to which I have referred requires no irrigation, while the greater portion of the remainder is very favorably situated for the easy application of water. On the plains at some distance from the mountains this process will be much more difficult on many accounts, and yet I do not doubt that even in such situations it will be attended with success when systematically practised.‡

I have thus seemingly digressed from my subject in order to show that the reservation of 3,600 square miles of that portion of this area embracing its most remarkable features was well timed, in consideration of the destructive tendencies of civilization.

The following are extracts from the report of the Committee on the Public Lands, concerning the bill providing for this reservation: “Persons are now waiting for the spring to open to enter in and take possession of these remarkable curiosities; to make merchandise of these beautiful specimens; to fence in these rare

* Geological Survey of Wyoming and contiguous territory, 1870, p. 194. Washington, 1871.

† *Ibid.*, p. 195.

‡ I take pleasure in referring the reader to the valuable reports of Dr. Thomas, which have been published with those of Dr. Hayden, where the whole subject of irrigation is fully discussed.

wonders, so as to charge visitors a fee, as is now done at Niagara Falls, for the sight of that which ought to be as free as air or water.

If this bill fails to become a law this session, the vandals, who are now waiting to enter into this wonder-land will, in a single season, despoil, beyond recovery, these remarkable curiosities, which have required all the cunning skill of nature thousands of years to prepare." If such were the danger then, how much greater would it be when the surrounding country had become thickly populated.

Having thus proven the wisdom of this liberal appropriation, let us turn our attention to a brief review of the main features of the park in its present wild condition.

First, as regards the evidences of waning subterranean heat, so abundantly manifested within the limits of this reservation. It is a remarkable fact that the springs in different localities are widely dissimilar in many respects, and even those in the same locality often differ as greatly from each other in some of their characteristics. The White Mountain hot springs of Gardiner's River are a noteworthy example of this, and did there exist no other reason for the formation of a park in this region, the fact that here the successive steps in the history of the ancient volcanic action are so clearly portrayed is alone sufficient ground for their protection. I venture to say that nowhere in our country, not even in the truly wonderful cañon of the Colorado, is so much of geological history crowded into such narrow limits, as in this portion of the Yellowstone basin. Nowhere in the world, I had almost said, is there to be found such an infinite variety with so small an expenditure of material. The area within which all this is comprised is much less than ten square miles. Some of the most interesting products are so delicate, and many of them are formed in situations so peculiar, that frequently the work of years might easily be demolished in a very few seconds. It is true that in many cases spoliation may be rectified, but there are numerous formations which have been and are now progressing so slowly, that the work of accumulation can barely keep pace with the destructive effects of natural erosion.

And yet this remarkable section furnishes but a small portion of the attractions of the park to the scientific observer. Hot and cold springs, mud volcanoes, fumaroles, solfataras and geysers,

rapids, waterfalls and torrents, deep-cut cañons and craggy peaks abound in every direction; lakes, gorges and cataracts, surprise one almost at every turn, and the whole is situated at a point where "the grand Rocky Mountain system culminates in a knot of peaks and ranges enclosing the most remarkable lake basin in the world. From this point radiate the chief mountain ranges, and three of the longest rivers of the continent, the Missouri, the Columbia and the Colorado."*

These being preserved by act of Congress, the earnest student of nature will always find an abundance of fresh matter for research in nearly every department of science. Here he will find ready to his hands a laboratory of physics in which he may observe on a large scale the action of the various forces of attraction and repulsion, and new illustrations of the correlation and conservation of energy cannot fail to attract his attention. He will find the laws of crystallization exemplified in forms novel and instructive, and will doubtless witness many new and varied phenomena of heat, light and electricity.†

The chemist will interest himself in problems of analysis and synthesis, in the processes of evaporation, condensation and solution, and the chemical changes incident thereto. To the botanist and the vegetable physiologist, the field is open for observation and wide experimentation, but there exists, even at this great altitude, a storehouse of facts bearing upon the distribution

* Wonders of the Yellowstone, edited by James Richardson. New York, Scribner, Armstrong & Co., 1873.

† In the Geological Survey of Montana, Idaho, Wyoming and Utah, 1872, p. 121.

Dr. A. C. Peale, mineralogist of Hayden's expedition of that year, notices a peculiar electrical phenomenon witnessed, or rather, experienced, by himself in company with two others of the party while ascending a peak near the Gardiner's River springs.

At page 807 of the same volume, Mr. Henry Gannett thus describes this "singular experience." "A thunder-shower was approaching as we neared the summit of the mountain. I was above the others of the party, and when about fifty feet below the summit the electric current began to pass through my body. At first I felt nothing, but heard a crackling noise, similar to a rapid discharge of sparks from a friction machine. Immediately after, I began to feel a tingling or pricking sensation in my head and the ends of my fingers, which, as well as the noise, increased rapidly, until, when I reached the top, the noise, which had not changed its character, was deafening, and my hair stood completely on end, while the tingling, pricking sensation was absolutely painful.

Taking off my hat partially relieved it. I started down again, and met the others twenty-five or thirty feet below the summit. They were affected similarly, but in a less degree. One of them attempted to go to the top, but had proceeded but a few feet when he received quite a severe shock, which felled him as if he had stumbled. We then returned down the mountain about three hundred feet, and at this point we still heard and felt the electricity.

and fertilization of plants, and the almost indefinite related subjects. The zoölogist and the student of comparative anatomy may also hope for rich rewards, in but partially explored fields, and the meteorologist, astronomer, artist and physician, may each find here full employment for his peculiar talent. Speaking from a geological standpoint, I can, from my own experience, promise the enthusiastic student of our earth's history a view at once so complete and so overwhelming as to enchain his whole attention.

Secondly, I consider that the Yellowstone National Park can be made a really valuable laboratory and conservatory of science at little cost and without detriment to any of the interests before mentioned.

Momentous questions are now agitating the scientific world, calling for experiment and observation which are daily becoming less possible, owing in a great measure to the obliterating influences of modern civilization. Thus it would almost seem that the present difficulties in the way of the solution of many questions, bearing upon the process of natural selection, will soon become insurmountable if some means are not employed to render more practicable the study of animals in a state of nature.

I have not space to treat this subject as it deserves, but for this and other reasons, I desire to call attention to what appears to me one of the most important uses to which the park can be put, viz.: *the preservation from extinction of at least the characteristic mammals and birds of the west, as far as they can be domiciled in this section.** The astonishing drain upon the American bison caused by the very extensive use of the buffalo robe, has led to the almost reckless waste of the life of an animal of the greatest value. I am not disposed to question the right of a nation to decide as to whether it will utilize its wild productions or supply their waste by the laborious and costly processes of civilization. We are now concerned only with the question of extinction and its relation to our researches.

If the reader will bear with me for a moment, while I bring to his notice a very few of the facts in the case, I am persuaded that he will agree with me in the statement that unless prompt and vigorous measures are instituted to check the wholesale slaughter,

*I say nothing of the reptiles, amphibians and fishes, principally because they are in much less danger of extinction, but also on account of the difficulties and disadvantages of settlement in a new region, which might result adversely.

now in progress in our western wilds, the *zoölogical record of to-day must rapidly pass into the domain of the palæontologist*. I select for my purpose only the more prominent of the many examples which might be given of animals in the west, which are rapidly becoming extinct through the agency of man—directly or indirectly at the hand of *civilized* man.

The American bison (*Bos Americanus* Gmelin), according to Rütimeyer, is identical with *Bison priscus* of the British palæolithic or drift deposits. The European aurochs (*Bos bison* or *Bison Europæus*) cannot be *specifically* separated from the latter, (*B. priscus*), however, for it is possible to trace the gradations between them. Sir J. Lubbock asserts that “the American form of bison is the more archaic.”* It is, perhaps, somewhat remarkable that an ancient genus containing forms so well suited to supply man with many of the comforts and luxuries of life, should, notwithstanding the better adaptations produced by domestication and careful breeding, still be so well represented by members in a wild state.† The aurochs is now nearly extinct, but some are found in the Carpathian Mountains and the marshy forests of Poland, while it is said to be represented by a few individuals in western Asia, in the neighborhood of Mount Caucasus. Several hundred were for a long time carefully preserved by the emperor of Russia, in the forests of Lithuania, but little is now generally known concerning them, and it is to be feared that they are there nearly or quite exterminated.

The urus (*Bos primigenius*), according to one historian‡, existed in Switzerland as late as the sixteenth century.

The American bison formerly ranged over a very large portion of this country east of the Rocky Mountains, extending even to the Atlantic, and southward into Mexico. In 1862, according to Baird, “its main range was between the upper Missouri and the Rocky Mountains, and from northern Texas and New Mexico to Great Martin Lake in latitude 64° N.”§ This was equivalent to an area of 1,500,000 square miles. To-day they roam over

* Prehistoric Times, 1869, p. 306.

† Besides the American bison and the aurochs there are now existing wild in India, the buffalo (*Bos bubalus* Linn), and the arnee (*B. arni* Shaw); in southern Africa, the Cape buffalo (*B. Caffer* Sparrm.); in central Asia, the yak, or grunting ox (*B. grunniens* Pall.); and in the Malayan Archipelago, the banteng (*B. Sondaïens*).

‡ Heberstain.

§ Dana, Manual of Geology, 2d ed., p. 580.

portions of this wide region, but the great railroads seem to present impassable barriers, which cause them to be distributed in lots, as it were, between them. I believe it to be a fair estimate to allow them a present range, all told, of not more than 500,000 square miles, a reduction of one million square miles in twelve years. Granting the possible fact that the reduction in numbers may be in smaller proportion, and allowing for errors in the calculation, *there can be little doubt that in the next ten years this race will become extinct*, at the present rate of destruction.

The wolverine (*Gulo luscus*) also represents an ancient type, found in the bone caves of England and Belgium. It is liable to rapid extinction on account of the value of its fur.

The Rocky Mountain grizzly bear (*Ursus horribilis* Ord.) is found by Mr. Buck* to be osteologically identical with remains occurring in ancient British deposits of Post-tertiary age. This species is, perhaps, not yet scarce enough to need protection, as it is mainly confined to mountainous regions, and the flesh is not greatly in demand. It is a question, however, whether its skin will not be more frequently sought in consequence of the disappearance of the bison, or buffalo.

The American beaver (*Castor Canadensis*), hunted alike for its skin and its anti-civilization propensities, is a distant relative of *Castoroides Ohiensis* of the American Post-tertiary. Its limits, as with other animals, have been much curtailed by the advance of civilized man. It is worthy of preservation for its peculiar habits, which need no description.

The tailless hare, or lagomys, represented in the Rocky Mountain region by the little chief hare (*L. princeps* Rich), "a genus now confined to the Himalayas, Siberia, and the colder regions of North America, has been identified by Prof. Owen among the bones from Kent's Cavern, and by Dr. Falconer among those from the Brixham Cave."†

The American moose (*Alce Americanus*) the equivalent of the Norway elk (now all but extinct in Europe) is another living representative of the Post-tertiary period. Though, at present, quite abundant in this country, it is doubtful whether it can long withstand the assaults of the hunter, even with the existence of stringent game laws. The same remark will apply with even

* Geological Journal, 1868.

† Sir J. Lubbock, Prehistoric Times, 1869, p. 307.

greater force to the black-tail (*Cervus Columbianus* Rich), and the cotton tailed deer (*C. leucurus* Douglas), the prong-horn antelope (*Antilocapra Americana* Ord), and particularly to the mule deer (*Cervus macrotis* Say) which is occasionally met in this region. I might also add, with equal propriety, the mountain sheep or big horn (*Ovis montana* Cuvier) and the various game members of the Rodentia, as well as, in fact, all the game birds of this region, including the ducks, geese, grouse, etc.

The mallard (*Anas boschas* Linn.) is the only bird of antiquity included in this fauna, remains of this species having been taken from the principal lake dwellings of Switzerland.

There are numerous other animals which might be included in this protective scheme, without interfering in the least with any plans for the best improvement of the park, and, what is, perhaps, of as much importance to our practical friends to whose influence we must look for its furtherance, without any serious addition to the burden of expense.* All of these animals are more or less

*The following *partial* list comprises only the more important of the mammals and birds observed by myself during the past summer (exclusive of those already mentioned), with some few additions from the report of Mr. C. H. Merriam, Zoologist of the Snake River Division of Dr. Hayden's expedition of 1872, in order to include a portion of the fauna of Idaho and Montana:—

MAMMALS.

Felis concolor Linn.—Cougar; Puma; Catamount.
Canis occidentalis, } var. *griseo albus* Rich.—White and Gray Wolf.
 } var. *nubilus* Say.—Dusky Wolf.
Canis latrans Say.—Coyote;—Prairie Wolf.
Putorius pusillus Aud. and Bach.—Least Weasel.
Putorius Richardsonii Bonap.—Little Weasel.
Lutra Californica Gray.—California Otter.
Mephitis mephitis, var. *occidentalis* Baird.—California Skunk.
Mephitis bicolor Gray.—Little Striped Skunk.
Taxidea Americana Waterh.—American Badger.
Procyon Hernandez Wagler.—California Raccoon.
Ursus Americanus Pallas.—Black Bear.
Sciurus Hudsonius Pallas.—Red Squirrel; Chickaree.
Sciurus Richardsonii Bach.—Richardson's Squirrel.
Pteromys alpinus Rich.—Rocky Mountain Flying Squirrel.
Tamias quadrivittatus Rich.—Missouri Striped Squirrel.
Spermophilus lateralis Rich.—Say's Striped Squirrel.
Spermophilus Townsendii Bach.—Townsend's Spermophile.
Cynomys Ludovicianus Baird.—Prairie Dog.
Cynomys Gunnisonii Baird.—Short Tailed Prairie Dog.
Arctomys flaviventer Bach.—Yellow-footed Marmot.
Fiber zibethicus Cuvier.—Muskrat.
Erithizon epizanthus Brandt.—Yellow-haired Porcupine.
Lepus Townsendii Bach.—Jackass Rabbit.
Lepus artemisia Bach.—Sage Hare.
Lepus sylvaticus Bach.—Gray Rabbit.
Lepus Bairdii Hayden.—Baird's Rabbit. ("One very curious fact relating to *Lepus Bairdii* is that all the males have teats and take part in suckling the young."—C. H. MERRIAM.) I have never met with this species myself.
Cervus Canadensis Ercl.—American Elk; Wapiti.

BIRDS.

My geological duties were too pressing to allow of any ornithological work; hence this meagre list of Birds:

Falco columbarius Linn.—Pigeon Hawk.
Falco polyagrus Cassin.—Prairie Hawk.
Tinnunculus sparverius Vieill.—Sparrow Hawk.
Accipiter Mexicanus Sw.—Blue-backed Hawk.

liable to rapid extermination by reason of their value to man. None of them need be considered dangerous when unmolested, and, in fact, the same may be said of the whole fauna of this region, without exception.* It is only when wounded, or pressed by the severest hunger that any one with ordinary presence of mind need fear to meet the most powerful of these brutes, entirely unarmed.†

Thirdly, we have here, and may retain without the necessity of protective measures, a large number of invertebrate animals whose habits are little known, and whose structure has scarcely been investigated, and this remark will apply as well to the lower members of the vertebrate series. There is, perhaps, much reason to look for a *peculiar* fauna in this restricted region, both on account of its altitude and its comparatively isolated position, as well as the severity of the climate at certain seasons of the year.‡

Buteo calurus Cassin.—Red-tailed Black Hawk.
Pandion Carolinensis Bonap.—Fish Hawk; Osprey.
Athene hypogæa Bonap.—Burrowing Owl; Prairie Owl.
Picus Harrisii Aud.—Harris' Woodpecker.
Picoides dorsalis Baird.—Striped Three-toed Woodpecker.
Sphyrapicus ruber Baird.—Red-breasted Woodpecker.
Melanerpes erythrocephalus Sw.—Red-headed Woodpecker.
Ceryle alcyon Boie.—Belted Kingfisher.
Turdus migratorius Linn.—Robin.
Sialia arctica Sw.—Rocky Mountain Bluebird.
Agelaius phoeniceus Vieill.—Red-winged Blackbird.
Pyrranga ludoviciana Bonap.—Louisiana Tanager.
Mimus Carolinensis Gray.—Cat Bird.
Spizella socialis Bonap.—Chipping Sparrow.
Corvus Americanus Aud.—Common Crow.
Corvus carnivorus Bart.—American Raven.
Pica hudsonica Bonap.—Magpie.
Zenaidura Carolinensis Bonap.—Carolina Dove.
Tetrao obscurus Say.—Dusky Grouse.
Centrocercus urophasianus Sw.—Sage Cock; Cock of the Plains.
Bonasa umbellus, var. *umbelloides* Baird.—Gray Mountain Grouse.
Cygnus buccinator Rich.—Trumpeter Swan.
Bernicla Canadensis Boie.—Canada Goose.
Nettion Carolinensis Baird.—Green-winged Teal.
Pelecanus erythrorhynchos Gm.—American Pelican.

* I make this statement advisedly, for, although I have repeatedly been exposed to attacks from predatory animals in this country and in Brazil, including the black, cinnamon and grizzly bears, the puma, jaguar, wolverine and wolf, and even the venomous reptiles such as the rattlesnake and the boa, I have always found them ready to run at my approach. The alligator, also, which has such a terrible reputation, is an arrant coward, and attacks man only when the chances are greatly in its favor.

† The protection of those animals which constitute the principal food of the more ferocious kinds would cause the occurrence of excessive hunger to become so very rare that no danger need result from this source.

I am aware that my ideas upon this subject are quite novel to many, but I believe them to be supported by the facts, as well as by the testimony of experience. My own observation, *by itself*, is of little value, but I have based my conclusions very largely upon the evidence of those whose wide knowledge of the habits of these animals in a state of nature best qualifies them to judge.

‡ The lowest point within the limits of the park is probably at the mouth of Gardiner's River, about 5,400 ft. above sea level, and this is quite exceptional, being on the northern boundary line of the reservation. Yellowstone Lake has an elevation of

It is interesting to observe, however, that a very large proportion of the animals here discovered belong to species of wide range, or, if more local in their distribution, they frequently represent districts far removed. But perhaps the most remarkable feature of this distribution is that we find here living, apparently under quite similar conditions, representatives of peculiarly *southern* and peculiarly *northern* types, with some representatives of *Pacific* types.* This opens to view at once a wide field for observation upon the habits and economy of a large number of the diversified group of insects.

The stridulation of insects, and the various sexual variations and appendages, may all be here studied to the very greatest advantage. I might give from my own notes upon these and other subjects, taken while deeply engaged in arduous duties of another nature, many interesting observations which, in many cases, I was absolutely *compelled* to make, so abundant was the material everywhere present.

Fourthly, there would be much to say upon many subjects connected with the botany of this region, were it not that its elucidation has been intrusted to much abler minds than mine. Pre-

7,800 ft., and there are numerous peaks whose altitude is nearly or quite 10,000 ft., while a number rise several hundred feet above these.

During the summer months the climate is mild and even hot in the daytime, but in clear weather the nights are very cold and frosts are not uncommon. This is due to the excessive radiation, which, during cloudy nights is, of course, much less, and the temperature consequently increased.

*The full discussion of this very interesting subject would be out of place in an article of this nature, but I cannot refrain from noticing what I believe to be the obvious explanation of this seemingly complex distribution. It must be remembered that, while this portion of country is hemmed in on all sides by high snow-clad walls, it is yet the main centre or heart of the aqueous circulation of a vast territory. The river channels of the sources of the Missouri, the Columbia, and the Colorado, cut through the otherwise impregnable rim of this basin, affording alike an outlet to the rains and melted snows, and an inlet to the insects and other animals which may by any means be forced to enter. Thus we may find, at the point from which their sources diverge, a few of the more hardy or more persecuted representatives of the lower valleys of these rivers. Were there no barriers of any kind between these points, we might expect to find whole groups of insects and the smaller animals, which had gradually moved upward and become acclimated here or even descended along the valleys of the other rivers. The facts show, however, that the representatives of distant districts now living in the Park are not thus connected in distribution with those districts. The natural conclusion, then, is that such park species are the descendants of accidentally introduced specimens which were hardy enough or fortunate enough to have completely crossed the barriers, instead of being destroyed *in transitu*. The great barrier, in this case, as remarked by Dr. Thomas, I believe to be the great plains which intervene between the head waters and the lower valleys of these great rivers, and perhaps, in one instance, the Sierra Nevada Mountains also form a barrier.

mising that Dr. C. C. Parry acted as the botanist of the north-western Wyoming expedition of 1873, I will only add that his observations prove that the rewards of research in that department are no less promising than in other fields.

Fifthly and lastly, there is one young but active science—microscopy,—which has as yet scarcely entered this field, but which, I firmly believe, will discover within the limits of the Park most valuable treasures. The act of Congress providing for this reservation insures the preservation of the greater portion of whatever may be available for this purpose.

Among the most interesting objects for the microscope, will be found the colloidal and filamentous products of the hot springs,* the minute vegetable and animal life of both hot and cold springs, the animal and vegetable parasites, and the numerous crystalline deposits of the hot springs and geysers.

Yellowstone Lake, in many places near its borders, is so completely filled with a soft greenish substance in small pellets, that it is impossible to dip a cupful of the water without including hundreds of them. They are apparently of vegetable origin, but careful microscopical investigation is needed to determine their ultimate structure. Whether this green matter has anything to do with the presence of the intestinal worms (*Dibothrium cordiceps* Leidy),† so abundant in the trout of the lake, I cannot say, but the idea has been suggested to me from facts observed in this connection.‡ The whole subject of intestinal parasites is extremely interesting, and this particular case is, on many accounts, more than ordinarily so. The successive stages in the development of this species, and the conditions necessary to its metamorphoses, have never been studied. I can only say that I do not regard the intestinal cavity of civilized man as one of its habitats, but more extended observation of its habits may prove the contrary.

It would be a pleasant task to continue my subject much farther, but I feel that I have written all that is needed to prove the scien-

* I use the terms *colloidal* and *filamentous* to designate peculiar growths in the boiling springs, concerning the nature of which little is known.

† A description of this species, with two figures of the head, will be found in Hayden's Report on Montana, etc., 1871, p. 381.

‡ Hayden states (*ibid.*, p. 97) that these parasites are found only in the trout taken above the Upper Falls of Yellowstone River. This observation is, in the main, correct, but I have met them, *though rarely*, in those of East Fork, which leads me to suspect that they may occur in the main river below the falls. It is probable, I think, that their habitat is preëminently the lake.

tific value of the Yellowstone Park. At the same time, I am confident that I have in no degree over-estimated its value to science, but, on the contrary, I have been obliged to omit mention altogether of many points which might add greatly to the interest in this section of country, for lack of space to record them.

If anything which I may have said shall in any way aid in developing an interest in our park, or in any of the special departments of science which can there be best prosecuted with success, I shall be well repaid for my effort.

It must be remembered, however, that at present everything in this region is in a crude state, and it will be necessary to introduce gradually the requisite appliances for work, and means for the accommodation, transportation and sustenance of those who desire to work in this field. These will all come in due time, as the avarice of man leads him to discover these demands for his commodities, and in the meantime we may congratulate ourselves that the work of *destruction* is stayed.

I do not propose here to offer any suggestions nor to put forward any plans for the furtherance of scientific investigation; my purpose is accomplished if I have succeeded in making a lucid statement of the real facts of the case. In an article to appear in the succeeding number of the NATURALIST, it is my intention to enter more fully into the subject of the best methods for the improvement of this tract.

ON THE STRUCTURE AND AFFINITIES OF THE BRONTOTHERIDÆ.*

PLATES I, II.

BY PROFESSOR O. C. MARSH.

THE Miocene deposits on the eastern slope of the Rocky Mountains contain the remains of a group of gigantic mammals, of much interest, which have been named by the writer, *Brontotheridæ*.† Although these animals are less remarkable than the

* Published in part in the Amer. Jour. of Sci., vol. vii, Jan., 1874.

† Amer. Jour. Sci., vol. v, p. 486, June, 1873.